Control and Cybernetics

vol. **31** (2002) No. 4

Book review:

The Siegfried Prössdorf Memorial Volume: Problems and Methods in Mathematical Physics

(Operator Theory: Advances and Applications. Vol. 121)

by

J. Elschner, I. Gohberg and B. Silbermann
(Editors)

This volume contains articles of participants of the 11th TMP (Conference on Problems and Methods in Mathematical Physics), held in Chemnitz, Germany, on March 25-28,1999. The conference was dedicated to the memory of Siegfried Prössdorf (02.01.1939-19.07.1998). Siegfried Prössdorf was a mathematician of high international reputation. He made essential contribution to the operator theory, to the theory and numerical analysis of integral equations and to the boundary value problems. The majority of the 23 articles of the volume are devoted to these fields. Moreover, the book contains three memorial reports by B. Silbermann, V. Maz'ya and J. Sprekels, the list of publications of S. Prössdorf, and the list of Dissertations directed by Him.

Now, concerning the articles contained in the volume. We start with the reports, which are devoted to some problems of the general operator theory and first of all the article of S. Prössdorf, and M. Yamamoto, in which ill posed operator equations are considered. The authors admit power evaluations of the resolvent and work out some discretization methods for solving these equations with evaluations of the solution errors and condition numbers. The work of I. Gohberg and N. Krupnik contains a new formula, which connects the determinant of a polynomial operator pencil with its characteristic numbers. In the article of V. Maz'ya and T. Shaposhnikova we can find some new results concerning the description of a set of multiplies between some Bessel potential spaces.

The most famous books of Siegfried Prössdorf were devoted to the theory of singular integral operators. The papers by A. Bottcher, Yu. Karlovich and V. Rabinovich, as well as S. Grudsky, contain investigations on this theme. The first of them is devoted to the Fredholm theory of the algebra generated by singular integral operators with slow oscillating symbols on composed slow oscillating curves (including logarithmic spirals) in the case of weight spaces

with oscillating Muckenhaupt weights. In the second, the author considers wide classes of Toeplitz operators with strong oscillating symbols.

The article by H. Berger and D. Dai is devoted to the Riemann-Gilbert boundary value problem for singular Vekua systems. In the next two articles – of M. Efendiev and W. Wendland, and L. von Wolfersdorf, the nonlinear boundary value problems are considered. The first of these papers is devoted to the theory of the nonlinear Riemann-Hilbert problem, while the second – to an application of a nonlinear boundary value problem of the Poincaré type to a problem for the plane potential flow of an inviscous incompressible fluid around and through a circular cylinder of a porous material.

A large part of the articles contained in the volume are devoted to the theory of numerical analysis for integral equations. The articles of S. Roch, J. Prestin and K. Selig, U. Luther and G. Mastroianni, as well as A. Rathsfeld concern some general questions. And so, S. Roch introduces and investigates the so-called fractal algebras. With the help of them he establishes some results about limit behavior of pseudospectra and the numerical ranges for some approximate operator sequences. In the second article of this direction a new orthogonal trigonometric Schauder basis of minimal growth of the polynomial degree in the space of continuously periodic functions is constructed with the help of a periodic wavelet packet functions. In the third article the authors show that the norms of the Fourier projectors in the space of essentially bounded functions have a logarithmic growth in "n". The fourth work is devoted to construction of the new wavelet bases corresponding to the uniform triangular grid of a smooth boundary surface of a three-dimensional domain and application of these bases to some operator equations.

The next seven articles are devoted to numerical analyses of concrete integral equations. The works of C. Bourgeois and S. Niçaise, and of H. Harbrecht and R. Schneider are devoted to application of the Galerkin method on some wavelet basis to the solution of the heat and Laplace equations, correspondingly. In the paper of R. Grigorieff and I. Sloan the qualocation (in particular: collocation) methods are applied to singular integral equations with piecewise-continuous coefficients. The paper of W. Hackbusch and B. Khoromskij is devoted to application of a class of hierarchical matrices to solving of some elliptic problems. The application of a Banach algebra technique to investigation of stability of a collocation method is discussed in the work of P. Junghanns and G. Mastroianni. A quadrature method for the Cauchy singular integral equations with constant coefficients is revisited in the paper of C. Lauritta and G. Mastroianni. The paper of G. Vainikko is devoted to fast solvers of generalized airfoil equations on the basis of a fully discrete version of the trigonometric collocation method.

The remaining five articles are devoted to related fields. In the articles of D. Natroshvili and Z. Tediashvili, and of R. Plato the inverse problems are considered: a three-dimensional mixed inverse scattering problem and an inverse problem in groundwater filtration, respectively. A new approach to solving the Dirac equations, based on the use of complex quaternions, is presented in the

paper of V. Kravchenko. The article of J. Elschner and G. Schmidt provides the mathematical foundation of the analytic formulae for the derivatives of TM reflection and transmission coefficients of diffraction gratings. The article of R. Gorenflo and F. Mainardi presents, for the symmetric case of space-fractional diffusion processes, three random walk models in space and time.

The volume shortly characterised above can be recommended to the specialists in the domains of singular integral equations, numerical analysis and the applied branches of mathematical physics.

Sergey Grudsky

J. Elschner, I. Gohberg and B. Silbermann (Editors): *Problems and Methods in Mathematical Physics. The Siegfried Prössdorf Memorial Volume.* Birkhäuser Verlag, Basel–Berlin–Boston, 524 pages, 2001. ISBN 0-7643-6477-7. Price: EUR 140.40 (hardcover).